## REMARKS

This Amendment, submitted in response to the Office Action dated September 20, 2004, is believed to be fully responsive to each point of rejection raised therein. Accordingly, favorable reconsideration on the merits is respectfully requested.

Claims 1-10 are now pending in the present application.

### I. Rejection of claims 1, 3, and 5 under 35 U.S.C. § 103

Claims 1, 3 and 5 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over the document entitled "High-Resolution Multi-Spectral Image Archive: A Hybrid Approach" published by Francisco H. Imai and Roy S. Berns (hereinafter "Imai") in view of Smith (U.S. Patent No. 6,631,204).

The Examiner alleges that "Imai discloses a method of processing image data in which two images obtained by photographing an identical subject, a first image being of large pixel number and small channel number and a second image being of small pixel number and large channel number, are combined to create a third image of large pixel number and large channel number" as recited in claim 1.

As discussed on page 2, last line to page 3, line 2 in the specification for the present invention, Imai discloses the method in which "only luminance information is acquired from a silver halide photographic camera and combined with the color information from a multi-band camera, thereby producing a high-definition spectral image," and continues to describe

"however, this method still involves the cumbersome operation of bringing the image from a silver halide photographic camera into exact registry with the image from a multi-band camera."

Claim 1 further recites "principal component analysis...determining coefficients in linear sums so that said linear sums of a specified number of principal component vectors obtained by said principal component analysis render output values of said pixel of interest in said first image of large pixel number and small channel number...and determining spectral information..."

However, Imai does not disclose this aspect of the claim. More particularly, Fig. 1 of Imai describes performing principal-component analysis to a spectral data obtained from the spectral measurement on the *original* subject, to thereby acquire the eigenvector (see two blocks "Spectral Measurement" and "Eigenvector Analysis" on the upper left side of the Figure 1 flowchart of Imai). The spectral data subjected to the principal-component analysis is neither the image of small pixel number and large channel number nor the image of large pixel number and small channel number. Thus, the invention disclosed in Imai is distinctive from the invention of claim 1 in the present application.

Furthermore, Imai utilizes the acquired eigenvector in order to merely obtain the spectral reflectance from the low-resolution multi-spectral image and further to obtain the L*a*b value. The block "Image Fusion" shown in Figure 2 does not contain principal-component analysis or an eigenvector explicitly indicating that principal-component analysis or eigenvector is utilized in the step.

On the other hand, the present invention performs principal component analysis on the image data in a region including the image of small pixel number and large channel number to obtain the eigenvector, and utilizes the thus obtained eigenvector together with the value from the image of large pixel number and small channel number in linear sums of the eigenvector, thereby generating the image of large pixel number and large channel number.

Imai requires precisely bringing an image of large pixel number and small channel number and an image of small pixel number and large channel number into exact registry to generate an image of large pixel number and large channel number, whereas the object of an exemplary embodiment of the present invention is to utilize the eigenvector of the image of small pixel number and large channel number to thus eliminate the cumbersome operation of precisely bringing the two images into exact registry.

As illustrated in the attached figure (see Appendix), in an exemplary embodiment of the invention, in the image of large pixel number and small channel number shown on upper side in the figure, the present invention acquires the values A of the small channel number of the target pixel (e.g., the values of three numbers of R, G, and B). In the image of small pixel number and large channel number shown on the lower side, the present invention acquires the values B of the large channel number (e.g., a group of values of thirty two channels when a visible ray region is divided into thirty two channels) of the corresponding region which substantially corresponds to the target pixel in the image of large pixel number and small channel number shown on the upper side.

The thus acquired values B of large channel number as the data on the corresponding area is subjected to the principal component analysis, to thereby obtain the eigenvector values C. The obtained eigenvector values C in the corresponding region is utilized together with the values A of the small channel number of the target pixel to obtain coefficients in linear sums of the respective eigenvector values. The respective eigenvector values are added in accordance with the coefficients, to finally obtain the values D of the large channel number of the target pixel.

Accordingly, the image data on the image of the large pixel number and large channel number is obtained.

In an exemplary embodiment of the invention, even if the two (first and second) images are not in exact registry, such poor registry of the images may not significantly alter the eigenvector and thus the eigenvector is rather stable. Therefore, the corresponding region in the image of small pixel number and large channel number shown on the lower side in the figure may be enlarged compared with the target pixel in the image of large pixel number and small channel number shown on the upper side. Consequently, there would be very little influence even if the corresponding region is slightly out the exact registry from the target pixel.

A large error may occur if the corresponding region is enlarged too much in order to obtain the large channel number from the linear sums of the eigenvector. However, by restricting the corresponding region to the vicinity region of the target pixel, the large channel number may be obtained with sufficient accuracy.

Accordingly, the present invention provides a significant advantage to eliminate the cumbersome operation of bringing the image of large pixel number and small channel number and the image of small pixel number and large channel number into exact registry for obtaining the image of large pixel number and large channel number.

On the contrary, Imai requires the first step of geometrically registering the image of large pixel number and small channel number and the image of small pixel number and large channel number. In addition, the prior art does not disclose the linear sums of the principal component vector nor determines the coefficients in such linear sums from the high-resolution image.

The Examiner states that Imai teaches all of the elements of claim 1, except the determining linear sums aspect of claim 1, and cites Smith to cure the deficiency.

In particular, the Examiner states that Smith teaches eigenvector analysis, and that eigenvector analysis is also known as principal component analysis, which is used to determine similarity, registration and alignment in images. Further, the Examiner states that eigenvector analysis causes images to be represented as a weighted linear combination of the eigenvectors which are represented by coefficients.

However, the Examiner cited Imai for teaching the principal component analysis of claim 1. Therefore, it is unclear why the Examiner is citing the Smith reference for also teaching principal component analysis. Therefore, assuming Smith teaches the claimed principal

component analysis as stated by the Examiner, the Examiner has failed to establish where determining coefficients in linear sums, as further recited in claim 1, is disclosed in the prior art.

Further, Smith discloses a "Similarity Measurement Method For The Classification of Medical Images Into Predetermined Categories," in which eigenvectors for each category are mathematically derived, and each image in each category is represented as a weighted linear combination of the eigenvectors. Smith, however, merely discloses each image in each category may be represented as a weighted linear combination of the eigenvectors, and does not disclose performing principal component analysis on the low-resolution image (represented by image data of small pixel number and large channel number). Assuming *arguendo* that the principal component vectors are similar to the eigenvectors and that the weighted linear combination of the eigenvectors are similar to the linear sums of the principal component vectors, Smith does not disclose determining the coefficients in such linear sums from the high-resolution image. Smith describes a method of classifying images by using eigenvectors. See abstract. Images are indexed, Fourier transformed and grouped into a matrix. See col. 3, lines 47-55. Eigenvectors and eigenvalues of the matrix are then calculated to obtain an eigenimage. See col. 3, lines 57-62. Using appropriate coefficients, an average matrix P can be reconstructed with eigenimages. See col. 4, lines 1-4. However, there is no disclosure of determining coefficients in linear sums.

Further, there is no disclosure in Smith of determining coefficients in linear sums so that the linear sums of a specified number of principal component vectors are obtained by *said principal component analysis*. More particularly, the purpose of Smith is to obtain eigenvectors and eigenvalues. Therefore, since Smith purports to obtain eigenvectors, there would be no

reason why the vectors obtained in Imai would be used to determine the eigenvectors (coefficients in linear sums as cited by the Examiner) of Smith.

Furthermore, Smith does not relate to the spectral image and thus does not obtain the spectral data of the target pixel.

For at least the above reasons, claim 1 and its dependent claims should be deemed patentable. Since claims 3 and 5 recite similar elements, claims 3 and 5 and their dependent claims should also be deemed patentable for at least the same reasons.

**II. Rejection of claims 2, 4, and 6 under 35 U.S.C. § 103**

Claims 2, 4 and 6 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Imai in view of Smith and further in view of Stubler (U.S. Patent No. 6,711,291).

Claims 2, 4, and 6 should be deemed patentable by virtue of their dependency to claims 1, 3, and 5 for the reasons set forth above. Moreover, Stubler does not cure the deficiencies of Imai and Smith.

**III. New claims**

Applicant has added claims 7-10 to provide a more varied scope of protection. Claims 7, 8 and 10 should be deemed patentable by virtue of their dependency to claim 1 for the reasons set forth above. Claim 9 describes subject matter similar to claim 3 and should be deemed patentable for the same reasons.

## IV. Specification Amendment

Applicant has amended the first full paragraph of page 10 of the specification to correct a grammatical error.

## V. Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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23373
CUSTOMER NUMBER

Date: February 22, 2005